P-8.6 Explain the relationship between mass and energy that is represented in the equation $E = mc^2$ according to Einstein's special theory of relativity.

Revised Taxonomy Levels   2.7 B   Explain conceptual knowledge

In physical science students were introduced to the concept of mass turning into energy in nuclear reactions and practical applications of this concept. Students are aware of the meaning of the equation $E = mc^2$.

It is essential for students to:
❖ Understand the equivalence of mass and energy.
❖ Understand that mass is a form of energy. A piece of mass even if not interacting with anything else has "energy of being" called rest energy. It takes energy to make mass and when mass disappears energy is released.
❖ The amount of energy E is equated to mass by the equation $E = mc^2$.
  ➢ The quantity c^2 is a conversion factor. It converts the measurement of mass to an equivalent measure of the amount of energy.
  ➢ In a nuclear reaction the total mass after the reaction is less than the mass before the reaction. The difference in mass is equivalent to the energy given off which can be calculated using this equation.
  ➢ Exothermic chemical reactions result in mass loss as well but since the energy given off is relatively small the mass loss is very small and difficult to measure.
❖ Mass and energy changes apply to energy transformations other than nuclear and chemical reactions. Any change in energy changes mass.

Assessment
As the verb for this indicator is <u>explain</u> the major focus of assessment will be for students to "construct a cause and effect model". In this case, assessments will ensure that students can model the relationship between mass and energy and the transformation between the two.

Because the indicator is written as <u>conceptual knowledge,</u> assessments should require that students understand the "interrelationships among the basic elements within a larger structure that enable them to function together." In this case, assessments must show that students can construct a cause and effect model relating mass and energy and the transformation between the two.